
Arum cylindraceum subsp. *pitsyllianum* (Araceae),
a New Taxon from Cyprus

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ABSTRACT. *Arum cylindraceum* Gasp. subsp. *pitsyllianum* Hadjik., Hand & G. Mans. (Araceae), a rare Cypriot endemic, is described as new. This diploid taxon differs from *A. cylindraceum* s. str. by the spathe tube that is whitish to greenish white internally with a pale purple horizontal strip just above the base and 3–4 cm long, the spadix, which is orange to orangish purple, and the anthers and connectives that are orange.

Key words: Araceae, *Arum*, Cyprus, IUCN Red List.

According to Boyce (1993, 2006), the genus *Arum* L. consists of 28 species, occurring from the Azores, North Africa, Europe, and eastward to China. *Arum megobrebi* Lobin, M. Neumann, Bogner & P. C. Boyce, an additional taxon, has been described recently (Lobin et al., 2007). The genus is represented in Cyprus by six species placed in various infragenera (cf. Boyce, 1993, 1994, 2006) and includes *A. italicum* Mill., *A. concinatum* Schott (section *Arum*), *A. sintenisii* (Engl.) P. C. Boyce (section *Dioscoridea* P. C. Boyce subsection *Dischroochiton* Schott), *A. rupicola* Boiss. (section *Dioscoridea* subsection *Tenuifila* (Engl.) P. C. Boyce), *A. hygrophilum* Boiss. (section *Dioscoridea* subsection *Hygrophila* P. C. Boyce), and *A. dioscoridis* Sm. (section *Dioscoridea* subsection *Poeciloporphyochiton* Schott). Both the new subspecies and *A. cylindraceum* Gasp. would assign to *Arum* sect. *Dioscoridea* subsect. *Alpina* P. C. Boyce. Recent molecular phylogenies of the genus are partially congruent with the morphological classification (Mansion et al., 2008; Espíndola et al., 2010; Linz et al., 2010), which suggests extreme caution when proposing a new classification without identifying nonmolecular synapomorphies.

In 1996, *Arum* specimens were collected by the first author from Madari Peak in Cyprus, and the same taxon was later found in the vicinity of Lagoudera village. Although it exhibited characters

of *A. cylindraceum*, the Cypriot plants differed in several details. Correspondence and two photographs of the plant (one showing the open spathe with spadix, and one showing the leaf blade) were sent to Peter Boyce (pers. comm., 2004), who confirmed the determination and stated: “This is a new record for Cyprus (indeed a new record so far east in the Mediterranean)—the nearest population in the Mediterranean is Crete, although there are isolated populations in continental West Turkey.” Since then, new populations have been found in Cyprus and afford a broader view.

So far, the taxonomy of *Arum cylindraceum* does not appear to be fully clarified. This is suggested by the fact that the two taxa *A. cylindraceum* (earlier treated under the synonym *A. alpinum* Schott & Kotschy) and *A. lucanum* Cavara & Grande, first accepted by Boyce (1993), were later classified together (Boyce, 2006). As regards the latter taxon, Boyce (2006: 134) stated that “without a shadow of doubt...it too is referable to the prioritized *A. cylindraceum*.” This is somewhat surprising, for the two taxa were originally placed in two different subsections, with *A. lucanum* assigned to subsection *Dischroochiton* Schott and *A. cylindraceum* (= *A. alpinum*) to subsection *Alpina*. The synonymy of these names is currently generally accepted (see Bedalov & Küpfer, 2005, for taxonomic concepts), but a recent molecular study by Linz et al. (2010: 413) found that the two taxa “did not form a group.” The study by Espíndola et al. (2010: 27) indicated that even *A. cylindraceum* s. str., as a taxon that excluded *lucanum*, may be paraphyletic. They recommend that “future taxonomic revisions should carefully consider characters not related to pollination” because of probable convergent evolution.

MATERIAL AND METHODS

Extensive research has been carried out in the field, taking into consideration all known populations of the new taxon. Plants collected in the field were

also cultivated in the Botanical Garden Berlin-Dahlem for further morphological, karyological, and molecular investigations. Chromosome counts were performed on three different specimens found in two field localities (indicated by asterisks among the Paratypes listed in this article), following the methodology described by Vogt and Aparicio (2000).

RESULTS

MORPHOLOGICAL STUDY

No taxon of the genus other than *Arum cylindraceum* shows the same combination of key characters such as the discoid tuber, the more or less greenish-colored inner surface of the ovate spathe limb, the filiform staminode and pistillode bristles, the slender clavate spadix, and the spring flowering. A close inspection of specimen characters in the field, in cultivated plants, and in herbarium material revealed that the plants from Cyprus differ slightly from *A. cylindraceum* in certain consistent characters, which together provide sufficient evidence to treat the new taxon as a geographically isolated subspecies.

Chromosome number. All counts revealed $2n = 28$, a diploid number within the genus.

TAXONOMIC TREATMENT

1. *Arum cylindraceum* Gasp., Fl. Sic. Prodr. 2(2): 597. 1844. *Arum italicum* var. *cylindraceum* (Gasp.) Nyman, Consp. Fl. Eur. 755. 1882. TYPE: [Italy] "in herbosis montosis; Madonie al piano della battaglia di petralis," s.d., *Gasparriani s.n.* (type, FI, cf. Boyce, 1993).

1a. *Arum cylindraceum* subsp. ***pitsyllianum*** Hadj. & G. Mans., subsp. nov. TYPE: Cyprus. Div. 2 (sensu Meikle, 1977), Troodos mtn. range, above Lagoudera, Pitsyllia area, Lefkosia district, under *Corylus* sp., ca. 1200 m, 30 May 2009, *G. Hadjikyriakou 7070* (holotype, B; isotypes, B, CYP, MO, Hb. Hadjikyriakou). Figure 1.

Subspecies nova quae ab *Aro cylindraceo* Gasp. subsp. *cylindraceo* tubo spathae 3–4 cm (non 2–3 cm) longo, appendice spadicis aurantiaca vel aurantiaco-purpurea (non fusca vel atropurpurea) atque antheris aurantiacis (non purpureis) differt.

Tuberous herb, sprouting in late winter, February to March; tuber discoid, vertically, sometimes horizontally oriented, 2–4 × 1.5–3 cm. Petiole, including the sheath 15–30(–38) cm × 3–5 mm,

canaliculate above, semicircular below, dark to light green, sometimes stained purple along the sheath margin and at the base of the petiole. Leaf blade constantly sagittate, apex acute to subacute, 6–15 × 4–10 cm, dark to light green; basal lobes overlapping at the lower, inner side in younger leaves. Inflorescence unscented; peduncle from above the tuber 13–30(–39) cm × 2–7 mm, usually shorter, but sometimes equal to or longer than the petioles, terete, deep to open green; spathe 9–16 cm; spathe tube 30–40 mm, ± ovate, constricted above, externally pale to yellowish green, without purple stains at the base, but sometimes present along the margins, interior whitish to greenish white, with a pale purple horizontal strip just above the base, up to 1 cm wide or with a few traces of the strip visible; spathe limb ovate-lanceolate, up to 12 × 6 cm, erect or slightly cucullate, acuminate, pale to yellowish green externally, sometimes purple tinged along the margins, internally pale to yellowish green, with or without purple margins; spadix not more than 1/2 to 3/4 the length of the spathe, limp, 5.4–7.5 cm in total length, the floral groups lying close to each other or with a very short space in between; spadix appendix and stipe clavate, evenly tapering toward stipe, 30–40 × 1.5–5 mm, appendix up to ca. 10% wider than stipe, appendix orange to orangish purple, the stipe yellow, sometimes dirty yellowish purple. Staminodes usually in 3 whorls, forming a zone 3–5 mm wide, bristles filiform, slightly flexuous to semirigid, constantly pointing downward, rarely a few nearly horizontal, 5–6 mm long, creamy white all over, bases conic, verrucate, creamy. Staminate flowers forming a zone 4–6 mm wide, anthers and connectives orange. Pistillodes mostly in 2 to 3 whorls forming a zone of about 5 mm wide, bristles filiform, rigid to semirigid, mostly pointing upward, creamy white, bases bulbiform, creamy white. Pistillate flowers in a cylindrical cluster 10–12 mm long, ovaries spherical, greenish yellow, stigma brownish. Fruiting spike oblong-cylindrical, 3–4 cm long, ca. 2.5 cm wide; berries somewhat angular to irregularly shaped, (6–)7.5–9(–10) × 5–7(–10) mm, red to reddish orange; seeds 1 per fruit, broadly elliptic to globose, pale brown, net-veined to pitted, 4–7 × (3.5–)4–5.5 mm.

Phenology. *Arum cylindraceum* subsp. *pitsyllianum* was observed to flower from May to the beginning of June.

Etymology. The Pitsyllia area is located in the central to eastern part of the Troodos mountain range, which extends from the Platania forest station to the western slopes of Machairas Peak, at altitudes between 500 and 1600 m. The epithet of the new

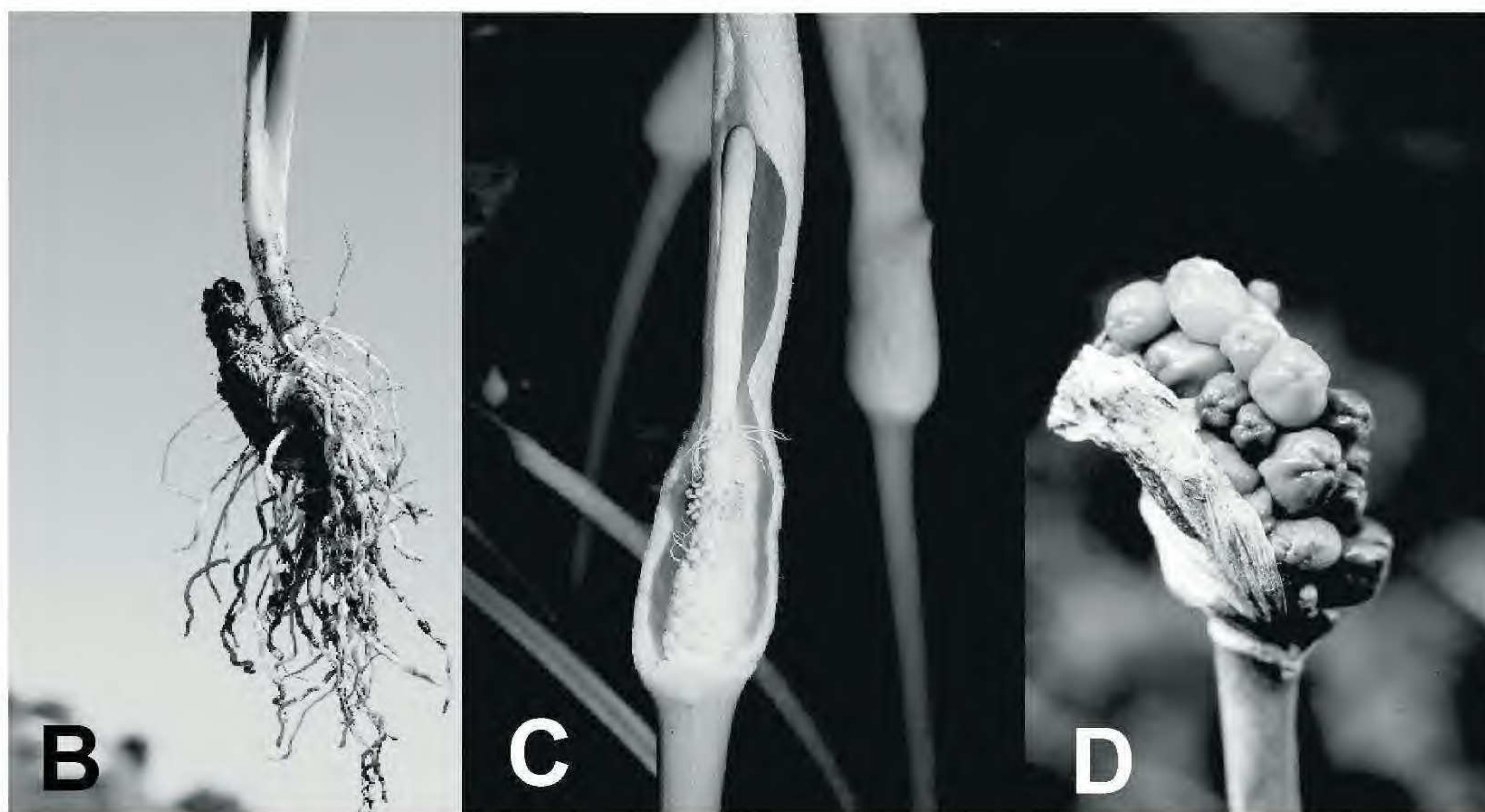


Figure 1. *Arum cylindraceum* subsp. *pitsyllianum* Hadjik., Hand & G. Mans. —A. Habit of flowering plant. —B. Tuber. —C. Inflorescence with partially removed spathe. —D. Infructescence. Photographs in A, B, and D by G. Hadjikyriakou: A, 7 May 2010, above Lagoudera; B, 30 May 2009, above Lagoudera; D, July 2002, Madari. Photograph in C by C. S. Christodoulou, 28 May 2009, Papoutsas.

subspecies is attributed to the Pitsyllia site, because investigations so far have shown that the taxon is restricted to that landscape.

Distribution and ecology. *Arum cylindraceum* subsp. *pitsyllianum* was first collected in the environs

of Madari Peak (1450–1580 m in altitude) on scree slopes and under *Quercus alnifolia* Poech. At a later stage it was located in *Corylus* L. groves in the environs of Lagoudera village (ca. 1200 m). In 2009, the new taxon was found on Papoutsas Peak (1350–1550 m), about 9 km southeast of Madari, on rocky

places under *Q. alnifolia* (C. S. Christodoulou, pers. comm.). At the Madari and Papoutsas sites where *Q. alnifolia* forms more or less dense stands on rocky screes, the new *Arum* taxon was associated with the following shrubs: *Rosa chionistrae* H. Lindb., *Cotoneaster nummularius* Fisch. & C. A. Mey., *Juniperus excelsa* M. Bieb. subsp. *excelsa*, *Lonicera etrusca* Santi, and *Berberis cretica* L. The herbal layer consisted of, e.g., *Nepeta troodi* Holmboe, *Pterocephalus multiflorus* Poech subsp. *multiflorus*, *Galium aparine* L., *Geranium lucidum* L., *Geranium purpureum* (L.) Vill., *Ornithogalum chionophilum* Holmboe, *Paeonia mascula* (L.) Mill. subsp. *mascula*, *Poa bulbosa* L., *Anthemis plutonia* Meikle, *Arabis purpurea* Sm., and *Smyrniium rotundifolium* Mill. Vegetation of the *Corylus* orchards differed considerably. The shady stands of *C. avellana* L. and *C. maxima* Mill. show a very dense herbal layer comprised of *Alliaria petiolata* (M. Bieb.) Cavara & Grande, the rare *Epipactis microphylla* (Ehrh.) Sw., *Platanthera chlorantha* subsp. *holmboei* (H. Lindb.) J. J. Wood, *Smyrniium rotundifolium* Mill., *Rubus sanctus* Schreb., *Cyclamen cyprium* Kotschy, and *Viola odorata* L. The geological substratum belongs to the Troodos ophiolite complex, and the dominant rock type at Madari and Papoutsas peaks is composed of diabase dikes, whereas that of Lagoudera is composed of gabbro (Geological Survey Department [Cyprus], 1995).

IUCN Red List category. *Arum cylindraceum* subsp. *pitsyllianum* is a rare endemic taxon. The most serious threats are forest fires, agricultural activities, forestry, trampling, and road construction. According to IUCN (2001) criteria, the subspecies should be categorized as Endangered (EN) B1ac(ii–iv) + 2ac(ii–iv). This indicates that the extent of occurrence and the area of occupancy are severely fragmented and there are extreme fluctuations in the area of occupancy, the number of locations or subpopulations, and the number of mature individuals. The populations at Madari and Papoutsas were found within a proposed Natura 2000 site, and a habitat type of 9390 (*Quercus alnifolia* arborescent matoral; for further information on sites and habitat type categories, see European Environment Agency, 2011) is of priority. The population at Madari is found in the Adelfoi Main State Forest.

Discussion. Our study showed that the new taxon from Cyprus combines a set of characters that has not been found in any other population of *Arum cylindraceum*, a species that has been dealt with in great detail in the monograph by Boyce (1993). Because of the particular geographical distribution

and morphological features—and being well aware of the variability of *A. cylindraceum*—we rank the new taxon as subspecies replacing the typical subspecies in Cyprus, the easternmost Mediterranean island. We refrain from ranking the new taxon as at the species level because a number of qualitatively important characters are still present with *A. cylindraceum* (cf. Table 1).

Morphologically, both entities share a number of features such as the discoid tuber, the more or less clavate spadix appendix, similar coloration patterns of spathe, and the filiform staminode and pistillode bristles. Furthermore, cytological investigations support an identical, diploid, chromosome number for both taxa (Bedalov & Küpfer, 2005; Lendel et al., 2006).

The Cyprus taxon differs from the typical subspecies by the spathe tube, which is whitish to greenish white internally, with a pale purple horizontal strip just above the base, up to 1 cm wide or with a few traces of the strip visible (no strip in *Arum cylindraceum* subsp. *cylindraceum*). The spadix appendix is orange to orangish purple (vs. chocolate-brown to dark purple), and the anthers and connectives are orange (vs. purple and yellow). Furthermore, the new subspecies is a late winter sprouting plant, in comparison to earlier growth, autumn to early winter in the typical subspecies (cf. Table 1).

Recent phylogenetic studies (Mansion et al., 2008; Linz et al., 2010) support an *Arum cylindraceum* clade that included *A. apulum* (Carano) P. C. Boyce, *A. balansanum* R. R. Mill, *A. cyrenaicum* Hruby, *A. euxinum* R. R. Mill, *A. longispathum* Rchb., *A. purpureospathum* P. C. Boyce, along with the two subspecies of *A. cylindraceum* Gasp. (Mansion & Hand, unpublished). It is noteworthy that except for the new subspecies, no other members of the *A. cylindraceum* clade occur in Cyprus. In this island, the remaining species of *Arum* belong to different infragenera (cf. key for Greece and Cyprus by Boyce, 1994). The new taxon now replaces determinations of *A. cylindraceum* in Cyprus, and we treat it as a geographic vicariant at the rank of subspecies. The occurrences of the new subspecies in Cyprus are the easternmost for its distributional area; *A. cylindraceum* is known to occur from Spain to the Balkans and from Sweden to Crete and northwest Turkey at altitudes to 2000 m (Boyce, 1993). The map presented by Boyce (1993) and reprinted by Linz et al. (2010) is not fully convincing, at least regarding central Europe and parts of western Europe. In Germany (shown as part of the area) *A. cylindraceum* is not native, but is instead a very local established

Table 1. Morphological comparison of *Arum cylindraceum* Gasp. subsp. *pitsyllianum* Hadjik., Hand & G. Mans. and subspecies *cylindraceum*. Diagnostic differences for the newly described subspecies *pitsyllianum* are emphasized in boldface. The typical subspecies is considered in the broad sense, including *A. alpinum* Schott & Kotschy and *A. lucanum* Cavara & Grande in synonymy.

Taxon	<i>A. cylindraceum</i> subsp. <i>pitsyllianum</i>	<i>A. cylindraceum</i> subsp. <i>cylindraceum</i> *
Sprouting	late winter	autumn to early winter
Petiole, including sheath	canaliculate above, semicircular below, 15–30(–38) cm	terete, (6–)12–18(–23) cm
Leaf blade	consistently sagittate, 6–15 cm	sagittate to sagittate-hastate or ovate-cordate, 6–13 cm
Inflorescence odor	unscented	unscented or smelling weakly of dung
Peduncle length, from above the tuber	13–30(–39) cm × 2–7 mm, usually shorter, but sometimes equal to or longer than the petioles	shorter, equal to, or exceeding the petioles, 10–18 cm
Spathe tube	3–4 cm, constricted above, internally whitish to greenish white, with a pale purple horizontal strip just above the base, up to 1 cm wide or with a few traces of the strip visible	2–3 cm, moderately to barely constricted apically, internally the basal 1/3 very pale greenish white, the upper 2/3 purple or totally greenish white
Floral groups	lying close to each other or with a very short space in between	usually separated, with longer intervals between (see Galán & Castroviejo, 2007: pl. 83; Boyce, 1993: 88, pl. 4)
Spadix	5.4–7.5 cm	4–8 cm
Spadix appendix and stipe	clavate, apically slightly thicker, evenly tapering toward stipe, 30–40 × 1.5–5 mm, appendix orange to orangish purple , the stipe yellow, sometimes dirty yellowish purple	slender and cylindric, slightly to moderately clavate, long-stipitate, 20–50 × 2–4 mm, appendix pale chocolate-brown to dark purple, stipe fading to cream basally
Staminode whorls	3	2 to 6
Staminode bristles	filiform, slightly flexuous to semirigid, pointing downward , rarely a few nearly horizontal, 5–6 mm, creamy-white throughout	filiform, semirigid or filiform flexuous, 3–6 mm, position variable, some pointing upward, some horizontal, and some pointing downward (e.g., Galán & Castroviejo, 2007: pl. 83; Boyce, 1993: 88, pl. 4), cream or cream-tipped with purple
Staminate flowers	anthers and connectives orange	purple or anthers purple, connectives yellow (Boyce, 1993: pl. 4; Fielding & Turland, 2005: 464)
Pistillodes	mostly in 2 or 3 whorls	in 2 to 5 whorls
Pistillode bristles	filiform, rigid to semirigid, mostly oriented upward, creamy white	aristate, semirigid to filiform, flexuous, cream or cream-tipped with purple
Pistillate flowers	in a cylindrical cluster 10–12 mm, ovaries spherical	in a globose or an oblong-cylindrical cluster 4–20 mm, ovaries oblong or oblong-cylindrical to oblong-globose

*The values represent the merged details given for *A. alpinum* and *A. lucanum* in Boyce (1993).

alien in the northernmost part of the country (Jäger & Werner, 2005). In Austria, the nominal subspecies is restricted to the easternmost parts of the country and Carinthia (Fischer et al., 2008), whereas Bedalov and Küpfer (2005) stated that it is found only in southeast France.

It seems likely that populations of the *Arum cylindraceum* clade in Cyprus were isolated some time ago and are currently speciating through relictual isolation. Nonetheless, as stated by Espíndola et al. (2010), morphological characters referring to pollination syndromes can evolve quite

rapidly in *Arum*, and no definitive conclusion on the origin of the new subspecies can be inferred without rigorous biogeographic studies.

Paratypes. CYPRUS. **Madari:** 19 May 1996, *G. Hadjikyriakou 1827* (Hb. Hadjikyriakou); 22 May 1999, *Hadjikyriakou 4550* (Hb. Hadjikyriakou); 22 May 2002, *Hadjikyriakou 5422* (Hb. Hadjikyriakou); Chandria, Madari, along descending path below Adelfoi summit, 20 May 2005, **Hand 5039 & Hadjikyriakou* (B, B EtOH coll., B cult. acc. 153-04-05-20, cult. until 6 May 2008), *Cubr 45408* (B); above Lagoudera, 22 May 1999, *Hadjikyriakou 4542* (Hb. Hadjikyriakou); 25 May 2002, *Hadjikyriakou 5420* (Hb. Hadjikyriakou); 7 Mar. 2004, *Hadjikyriakou*

5928 (Hb. Hadjikyriakou); Lagoudera, below Polystipos jct., in a conspicuous rd. bend, 20 May 2005, *Hand 5036 & Hadjikyriakou (B [2], B cult. acc. 153-05-05-20), *Cubr* 46993 (B).

Acknowledgments. The authors thank Charalambos S. Christodoulou (Lefkosia, Cyprus) for his help with the preparation of this paper and photographs; Monika Lüchow (B) for help with the chromosome counts; Michael Meyer and his team of gardeners (B) for the cultivation of plants; Peter Boyce (Pulau Pinang, Malaysia) for species determination; Thomas Raus (B) for improving the Latin diagnosis; Kathleen Stephanides (Lefkosia, Cyprus) for editing the text; and Victoria Hollowell and two anonymous reviewers for pertinent and helpful comments.

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